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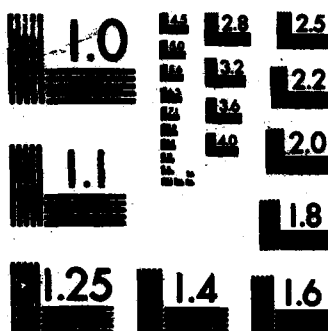
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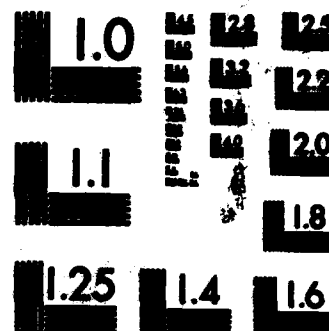
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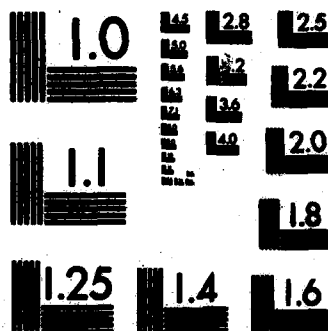
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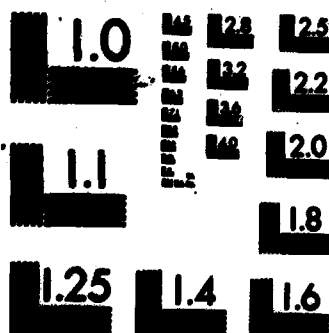
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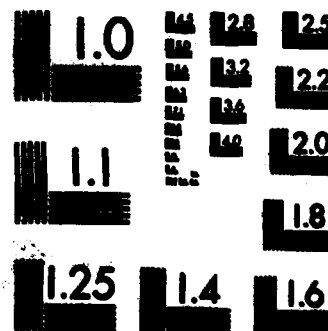
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FINAL REPORT CONCERNING ONR CONTRACT #N00014-80-C-0377 WITH THE UNIVERSITY OF TENNESSEE, IVAN A. SELLIN, PRINCIPAL INVESTIGATOR

With this report we transmit the final list of two books, two contributions to books, 96 articles which have appeared in the professional journals of physics and in proceedings of international meetings, and 93 other contributions to such meetings, all of which papers or books were based on work supported by this Contract. To provide an overview, we list here highlights of the research and discoveries made therein during the ten-year term of this Contract:

- o Study of lifetimes of metastable, X-ray and Auger-emitting highly ionized ions, to learn about the magnitude of violation of selection rules for radiative processes of various orders brought about by relativistic magnetic interactions involving core electrons and highly ionized atoms.
- o Invention and development of projectile electron spectroscopy, in which energy analysis of electrons emitted by ions undergoing Auger decay in flight can be used to study the lifetimes of highly ionized ions metastable against Coulomb autoionization. This method was found useful for studying core-excited ions which decay preferentially by Auger emission.
- o Discovery of strong projectile ionic charge-state dependence of inner-shell X-ray production processes for highly ionized projectiles. This discovery was the forerunner of much intensive activity concerning the physics of slow, high charge-state recoil particles being studied in collision experiments in accelerator laboratories throughout the world. It also is the basis for rapidly developing experiments on the trapping of high charge-state ions in electromagnetic bottles for the purpose of studying their collision interactions and spectroscopy.
- o Discovery of coherent electric dipole oscillations of electronic charge distributions of atoms coherently excited in thin foils, and in gases under single-collision conditions.
- o Measurement of transition probabilities for electrostatic fine structure transitions in lithium-like, beryllium-like, and boron-like ions of high nuclear charge. Relativistic effects on transition probabilities were the main effects of interest.
- o Discovery of large polarizations for continuum X-rays emitted in small impact-parameter ion-atom collisions.
- o Discovery of large isotope effects in inner-shell vacancy production by heavy ions near threshold.
- o Measurement of electron capture by highly ionized ions in atomic hydrogen in the adiabatic collision regime (quasi-resonant electron capture).
- o Measurement of electron capture by protons in atomic hydrogen at high velocities (three-body problem).

- o Investigation of electron loss to the continuum as manifested by the analysis of the shape and yield of the forward cusp observed in the emergent electron distribution subsequent to ion-atom collisions.
- o Investigation of the convoy electron peak accompanying the passage of high-speed heavy ions through solid matter. The properties of the electrons emerging from solid materials with nearly the same speed and direction as the ions which generate them have produced many surprises. Among them: The yield of electrons is found to be sensitive to the projectile nuclear charge, but not to the emergent projectile ionic charge.
- o Development of methods to exploit the large cross sections discovered for production of high charge-state recoil ions by trapping these ions in electromagnetic bottles. Methods for containing and studying collision interactions for such ions over a period of seconds were in an early stage of development at the end of the contract.

Attached is a list in chronological order by various categories of the publications arising from performance under this contract, listed by title, authors, and place of publication.

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PUBLICATIONS

Books

"Highly Ionized Ions," in Advances in Atomic and Molecular Physics, D. R. Bates and B. Bederson, eds., Academic Press, New York (1976), Vol. 12, p. 215.

"The Measurement of Autoionizing Ion Levels and Lifetimes by Fast Projectile Electron Spectroscopy," in Topics in Current Physics, Vol. 1: Beam Foil Spectroscopy, S. Bashkin, ed., Springer-Verlag, Heidelberg (1976), pp. 265-297.

Beam Foil Spectroscopy: Vol. 1, Atomic Structure and Lifetimes, Vol. 2, Collisional and Radiative Interactions, I. A. Sellin and D. J. Pegg, eds. Plenum Press, New York (1976).

Structure and Collisions of Ions and Atoms, I. A. Sellin, ed., Springer-Verlag, Heidelberg (1978); op. cit., "Extensions of Beam Foil Spectroscopy," Chapter 6.

Articles in Major Journals and Proceedings

"Metastable Autoionizing States of Highly Excited Heavy Ions," with D. J. Pegg, P. M. Griffin, and W. W. Smith, Phys. Rev. Lett. **28**, 1229 (1972).

"Metastable Autoionizing States in Sodium-like Chlorine," with D. J. Pegg, P. M. Griffin, and W. W. Smith, Phys. Rev. Lett. **28**, 1615 (1972).

"Beam Fractions in the Lowest-Quartet Metastable Autoionizing State for O^{5+} and F^{6+} Beams after Passage Through Foils," W. W. Smith, B. Donnally, D. J. Pegg, M. D. Brown, and I. A. Sellin, Phys. Rev. A **7**, 487 (1973).

"Metastable States of Highly Excited Heavy Ions," with D. J. Pegg, P. M. Griffin, W. W. Smith, and B. Donnally, in Atomic Physics 3, Plenum Press, London, p. 327 (1973).

"Projectile Structure Effects on Neon K X-Ray Production by Fast, Highly Ionized Argon Beams," with J. R. Mowat, P. M. Griffin, D. J. Pegg, and R. S. Peterson, Phys. Rev. Lett. **29**, 1577 (1972).

"Exponential Projectile Charge Dependence of Ar K and Ne K X-Ray Production by Fast, Highly Ionized Argon Beams in Thin Neon Targets," Proceedings of the Eighth International Conference on the Physics of Electronic and Atomic Collisions, B. Cobic and M. Kurepa, eds., Graficko Preduzece Buducnost, Zrenjanin, Yugoslavia (July, 1973), p. 727.

"Heavy Ions - Looking Ahead," with J. H. Hamilton, Physics Today **26**, No. 4, 42 (1973).

"Mean Life of the Metastable 2^3P_1 State of the Two-Electron Fluorine Ion," with J. R. Mowat, R. S. Peterson, D. J. Pegg, M. D. Brown, and J. R. MacDonald, Phys. Rev. **A8**, 145 (1973).

"Electron Spectroscopy of Foil-Excited Chlorine Beams," with D. J. Pegg, P. M. Griffin, and W. W. Smith, Nucl. Instr. and Meth. 110, 489 (1973).

"Metastable Autoionizing States," Nucl. Instr. and Meth. 110, 477 (1973).

"Exponential Projectile Charge Dependence of Ar K and Ne K X-Ray Production by Fast, Highly-Ionized Argon Beams in Thin Neon Targets," with J. R. Mowat, D. J. Pegg, R. S. Peterson, J. R. MacDonald, and M. D. Brown, Phys. Rev. Lett. 30, 1289 (1973).

"One- and Two-Electron Excited States Produced by Electron Exchange, Excitation, and Electron Capture in Collisions of Fluorine Ions in Argon Gas at 34.8 MeV," with J. R. Macdonald, P. Richard, C. L. Cocke, and M. D. Brown, Phys. Rev. Lett. 31, 684 (1973).

"Electron Decay-In-Flight Spectra for Autoionizing States of Highly Stripped Oxygen, Fluorine, Chlorine, and Argon Ions," with D. J. Pegg, R. S. Peterson, J. R. Mowat, W. W. Smith, J. R. Macdonald, and M. D. Brown, Phys. Rev. A8, 1350 (1973).

"Observation of Coherent Electron Density Distribution Oscillations in Collision-Averaged Foil Excitation of the $n=2$ Hydrogen Levels," with J. R. Mowat, R. S. Peterson, P. M. Griffin, R. Laubert, and H. H. Haselton, Phys. Rev. Lett. 31, 1335 (1973).

"Projectile Charge State Dependence of K X-Ray Production by 1-4 MeV/amu Heavy Ions in Gases," with J. R. Mowat, P. M. Griffin, D. J. Pegg, and R. S. Peterson, Phys. Rev. A9, 644 (1974).

"Initial UNISOR Research: New Isotopes ^{186}Tl , ^{188}Tl , ^{116}I ; Decays of ^{189}Tl , ^{190}Tl , ^{117}Xe , and ^{117}I ; and Off-Line Atomic and Nuclear Studies," published in the Proceedings of the Twenty-fourth Annual National Conference of the Academy of Science USSR on Nuclear Spectroscopy and Structure of the Atomic Nucleus, (1974).

"Observation of K X-Rays from Highly Ionized States of Neon Produced by 40 MeV Cl^{+7} , Cl^{+11} , and Cl^{+13} Beams," with M. D. Brown, J. R. Macdonald, P. Richard and J. R. Mowat, Phys. Rev. A9, 1470 (1974).

"Charge State Dependence of Si K X-Ray Production in Solid and Gaseous Targets by 40 MeV Oxygen Ion Impact," with S. Datz, J. R. Mowat, B. R. Appleton, J. A. Biggerstaff, and C. D. Moak, in Atomic Collisions in Solids, S. Datz, ed., p. 461 (1975).

"Lifetime and Binding Energy of the Metastable $(1s2s2p)^4P_{5/2}^0$ State in S^{13+} ," with D. J. Pegg, H. H. Haselton, P. M. Griffin, R. Laubert, J. R. Mowat, and R. Peterson, Phys. Rev. A9, 1112 (1974).

"Neon $\text{K}\alpha$, $\text{K}\beta$ Satellite Structure Induced by 80-MeV Argon-Ion Impact," with J. R. Mowat, R. Laubert, R. L. Kauffman, M. D. Brown, J. R. Macdonald, and P. Richard, Phys. Rev. A10, 1446 (1974).

"Radiative Transitions in Two-electron Oxygen," with D. J. Pegg, P. M. Griffin, H. H. Haselton, R. Laubert, J. R. Mowat, R. S. Thoe, and R. S. Peterson, *Physics Letters* 47A, 433 (1974).

"New Lines in the XUV Spectrum of Heliumlike Fluorine," with D. J. Pegg, P. M. Griffin, H. H. Haselton, R. Laubert, J. R. Mowat, R. S. Thoe, and R. S. Peterson, *Physics Letters* 47A, 467 (1974).

"XUV Spectra of Highly Ionized Fluorine and Oxygen," with D. J. Pegg, P. M. Griffin, H. H. Haselton, R. Laubert, J. R. Mowat, R. S. Thoe, and R. S. Peterson, *Phys. Rev. A* 10, 745 (1974).

"Autoionization Lifetimes of the Metastable $(1s2s2p)^4P_{5/2}$ State in the Lithiumlike Ions Al^{10+} , Si^{11+} , and S^{13+} ," with H. H. Haselton, R. S. Thoe, P. M. Griffin, J. R. Mowat, D. J. Pegg, and R. Peterson, published in the Proceedings of the Fourth International Conference on Atomic Physics, G. Zu Putlitz ed., Heidelberg, University Press, p. 79 (1974).

"Characterization of Charge States of Energetic Ions in Solids from Associated K X-Ray Production," with Sheldon Datz, B. R. Appleton, J. R. Mowat, R. Laubert, R. S. Peterson, and R. S. Thoe, *Phys. Rev. Lett.* 33, 733 (1974).

"Metastable Atomic States of Heavy Ions I: X-Ray Emitting States; II: X-Ray and Auger Emitting States; III: Auger Emitting States and Astrophysical Topics; Vol. II, Heavy Ion Lecture Series, Kansas State University, pp. 329, 352, and 380, respectively (1974). The other lecturers in this series were D. Allan Bromley, Eugen Merzbacher, Donald Robson, Frans Saris, H. Terry Fortune, J. D. Garcia and Walter Greiner.

"Symmetric Ion-Atom Collisions at Medium Energies I: Characteristic X-Rays," with R. Laubert, H. Haselton, J. R. Mowat, and R. S. Peterson, *Phys. Rev. A* 11, 135 (1975).

"Observation of Large and Strongly Energy-Dependent Directional Anisotropies in Non-Characteristic K X-Rays Emitted in Heavy Ion Collisions," with R. S. Thoe, R. Peterson, P. M. Griffin, D. J. Pegg, J. P. Forester, and M. D. Brown, *Phys. Rev. Lett.* 34, 64 (1975).

"Optically Inaccessible Core Excited States of Li and Na," D. J. Pegg, H. H. Haselton, R. S. Thoe, P. M. Griffin, M. D. Brown, and I. A. Sellin, *Phys. Lett.* 50A, 447 (1975).

"Variation of the Anisotropy of the Non-Characteristic X-Rays Emitted from Fast Ion-Atom Collisions," with R. S. Thoe, R. Peterson, P. M. Griffin, D. J. Pegg, J. P. Forester, and M. D. Brown, in Proceedings of the Third Conference on Applications of Small Accelerators, ERDA CONF-741040P1, p. 78 (1975).

"Lifetimes of the Metastable Autoionizing $(1s2s2p)^4P_{5/2}$ States of Lithiumlike Al^{10+} and Si^{11+} Ions: Comparisons with Theory over the Isoelectronic Sequence $Z = 8 - 18$," D. J. Pegg, P. M. Griffin, H. H. Haselton, R. Laubert, J. R. Mowat, R. S. Thoe, R. S. Peterson, and I. A. Sellin, *Phys. Rev. A* 11, 468 (1975).

"Symmetric Ion-Atom Collisions at Medium Energies: Non-Characteristic Radiation," with R. Laubert, H. H. Haselton, J. R. Mowat, and R. S. Peterson, Phys. Rev. A **11**, 1468 (1975).

"Heliumlike ^{19}F ; $^{23}\text{P}_2$ and $^{23}\text{P}_0$ Lifetimes," with J. R. Mowat, P. M. Griffin, H. H. Haselton, R. Laubert, D. J. Pegg, R. S. Peterson, and R. S. Thoe, Phys. Rev. A **11**, 2198 (1975).

"Photon Energy Dependence of the Asymmetry of Non-Characteristic X-Radiation in Si-Al and Al-Al Collisions," with R. S. Thoe, R. S. Peterson, D. J. Pegg, P. M. Griffin, and J. P. Forester, in Electronic and Atomic Collisions, J. S. Risley and R. Geballe, eds., Univ. of Washington Press, Seattle, p. 312 (1975).

"Autoionizing States Formed in $\text{Na}^+ + \text{He}$ and $\text{Mg}^+ + \text{He}$ Collisions at 70 KeV," with D. J. Pegg, H. H. Haselton, R. S. Thoe, P. M. Griffin, and M. D. Brown, in Electronic and Atomic Collisions, R. S. Risley and R. Geballe, eds., Univ. of Washington Press, Seattle, p. 869 (1975).

"Differences in the Production of Non-Characteristic Radiation in Solid and Gas Targets," with R. S. Peterson, R. Laubert, R. S. Thoe, H. Hayden, S. Elston, J. Forester, K.-H. Liao, P. M. Griffin, and D. J. Pegg, in Beam-Foil Spectroscopy: Heavy Ion Atomic Physics, I. A. Sellin and D. J. Pegg, eds., Plenum Press, New York (1976), Vol. 2, p. 497.

"Extreme Ultraviolet Spectra of Highly Stripped Si Ions," with P. M. Griffin, D. J. Pegg, T. Kruse, K. W. Jones, D. Pisano, and S. Bashkin, in Beam-Foil Spectroscopy: Heavy Ion Atomic Physics, I. A. Sellin and D. J. Pegg, eds., Plenum Press, New York (1976), Vol. 1, p. 321.

"Angular Distribution Studies on Non-Characteristic X-Radiation," with R. S. Thoe, K.-H. Liao, R. S. Peterson, D. J. Pegg, J. P. Forester, and P. M. Griffin, in Beam-Foil Spectroscopy: Heavy Ion Atomic Physics, I. A. Sellin and D. J. Pegg, eds., Plenum Press, New York (1976), p. 477.

"Autoionizing States in Highly Ionized O, F, and Si," with J. P. Forester, R. S. Peterson, P. M. Griffin, H. Haselton, K.-H. Liao, J. R. Mowat, D. J. Pegg, and R. S. Thoe, in Beam-Foil Spectroscopy: Heavy Ion Atomic Physics, I. A. Sellin and D. J. Pegg, eds., Plenum Press, New York (1976), Vol. 1, p. 451.

"Core-Excited Autoionizing States in the Alkalies," with D. J. Pegg, H. H. Haselton, R. S. Thoe, P. M. Griffin, and M. D. Brown, Phys. Rev. A **12**, 1330 (1975).

"Applications of Beam-Foil Spectroscopy to Atomic Collisions in Solids," Nucl. Inst. and Meth. **132**, 397 (1976).

"Polarization Measurements on the Non-characteristic Radiation Emitted from Collisions Between High Energy Aluminum Ions," with R. S. Thoe, R. S. Peterson, K.-H. Liao, D. J. Pegg, J. P. Forester, and P. M. Griffin, Phys. Letters **56A**, 89 (1976).

"Differences in the Production of Non-characteristic Radiation in Gaseous and Solid Targets," with R. Laubert, R. S. Peterson, J. P. Forester, K.-H. Liao, P. M. Griffin, H. Hayden, S. B. Elston, D. J. Pegg, and R. S. Thoe, Phys. Rev. Lett. **36**, 1574 (1976).

"Lifetimes and Transition Rates for Allowed In-Shell Transitions in Highly Stripped Sulfur," with D. J. Pegg, S. B. Elston, J. P. Forester, P. M. Griffin, H. C. Hayden, R. S. Peterson, and R. S. Thoe, in Proceedings of the Fifth International Conference on Atomic Physics, R. Marrus, M. H. Prior, and H. A. Shugart, eds., University of California, Berkeley, Calif. (1976) p. 166.

"An Experimental Survey of Electron Transfer in keV Collisions in Multiply Charged Ions with Atomic Hydrogen," with J. E. Bayfield, P. M. Koch, L. D. Gardner, D. J. Pegg, R. S. Peterson, and D. J. Crandall, in Proceedings of the Fifth International Conference on Atomic Physics, R. Marrus, M. H. Prior, and H. A. Shugart, eds., University of California, Berkeley, Calif. (1976) p. 126.

"Radiative Lifetimes and Transition Probabilities for Electric Dipole $\Delta n=0$ Transitions in Highly Stripped Sulfur Ions," with D. J. Pegg, S. B. Elston, P. M. Griffin, H. C. Hayden, J. P. Forester, R. S. Thoe, and R. S. Peterson, Phys. Rev. A 14, 1036 (1976).

"Dipole Oscillator Strengths for $\Delta n=0$ Transitions in Highly Ionized Sulfur," with D. J. Pegg, S. B. Elston, P. M. Griffin, H. C. Hayden, J. P. Forester, R. S. Thoe, and R. S. Peterson, Physics Lett. 58A, 349 (1976).

"Charge Dependence of K X-Ray Production in Nearly Symmetric Collisions of Highly Ionized S and Cl Ions in Gases," with J. R. Macdonald, M. D. Brown, S. J. Czuchlewski, L. M. Winters, R. Laubert, and J. R. Mowat, Phys. Rev. A14, 1997 (1976).

"Strong Isotope Dependence of K-Vacancy Production in Slow Ne^+ -Ne Collisions," with R. S. Peterson, S. B. Elston, R. Laubert, F. K. Chen, and C. A. Peterson, Phys. Rev. Lett. 37, 984 (1976).

"Projectile Charge-State Dependence in K-Shell Ionization of Neon, Silicon, and Argon Gases by Lithium Projectiles," with F. K. Chen, G. Lapicki, R. Laubert, S. B. Elston, and R. S. Peterson, Physics Lett. 60A, 292 (1977).

"Overcoming the Doppler Limitation in Beam-Foil Experiments by Target Ion Spectroscopy," in Proceedings, Fourth Conference on Scientific and Industrial Applications of Small Accelerators, J. L. Duggan and I. L. Morgan, eds. (International Association of Electrical and Electronic Engineers, Report 76 CH 1175-9 NPS, New York), p. 319 (1977).

"Production of Soft X-Ray Emitting Slow Multiply Charged Ions: Recoil Ion Spectroscopy," with S. B. Elston, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Peterson, R. S. Thoe, C. R. Vane, J. J. Wright, K. O. Groeneveld, R. Laubert, and F. Chen, Phys. Lett. 61A 107 (1977).

"The Splitting and Oscillator Strengths for the $2s^2S-2p^2P^0$ Doublet in Lithiumlike Sulfur," with D. J. Pegg, J. P. Forester, S. B. Elston, P. M. Griffin, K. O. Groeneveld, R. S. Peterson, R. S. Thoe, and C. R. Vane, Astrophysical J. 214, 331 (1977).

"Oscillator Strengths for In-shell ($\Delta n = 0$) Dipole Transitions in Li- and Be-like Sulfur," with D. J. Pegg, J. P. Forester, C. R. Vane, S. B. Elston, P. M. Griffin, K. O. Groeneveld, R. S. Peterson, and R. S. Thoe, Phys. Rev. A15 1958 (1977).

"Neon Characteristic X-ray Production in Neon-Neon Collisions as a Function of Incident Projectile Charge State", with R. S. Peterson, F. J. Chen, S. B. Elston, J. P. Forester, P. M. Griffin, H. C. Hayden, R. Laubert, C. A. Peterson, R. S. Thoe, and C. R. Vane in Proceedings, Tenth International Conference on the Physics of Electronic and Atomic Collisions, M. Barat, J. Reinhardt, and G. Watel, eds. (Commissariat a l'Energie Atomique, Paris), p. 894 (1977).

"Spin-dependent Excitation of Autoionizing States of Li Produced in Collisions with Noble Gas Targets", with S. Schumann, S. B. Elston, C. R. Vane, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Thoe, and J. J. Wright, in Proceedings Tenth International Conference on the Physics of Electronic and Atomic Collisions, M. Barat, J. Reinhardt, and G. Watel, eds. (Commissariat a l'Energie Atomique, Paris), p. 1014 (1977).

"Recoil Ion Spectroscopy in the XUV-Soft X-Ray Region Following Heavy Ion Impact on Thin Gas Targets", with S. B. Elston, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Peterson, R. S. Thoe, C. R. Vane, and J. J. Wright, in Proceedings, Tenth International Conference on the Physics of Electronic and Atomic Collisions, M. Barat, J. Reinhardt, and G. Watel, eds. (Commissariat a l'Energie Atomique, Paris), p. 634 (1977).

"High Resolution Studies of Extensive Ne L-Shell Excitation by Energetic Heavy Ion Impact," C. R. Vane, I. A. Sellin, F. Chen, S. B. Elston, J. P. Forester, P. M. Griffin, K.-O. Groeneveld, R. Laubert, D. J. Pegg, R. S. Peterson, R. S. Thoe, and J. J. Wright in Proceedings, Tenth International Conference on the Physics of Electronic and Atomic Collisions, M. Barat, J. Reinhardt, and G. Watel, eds. (Commissariat a l'Energie Atomique, Paris), p. 632 (1977).

"Observation of Zero-Field Quantum Beats in Gas-excited Helium Projectiles," J. Bromander, L. Liljeby and I. A. Sellin, Z. Physik A 283, 299 (1977).

"Studies of Neon L-Shell Excitation by Impact of Highly Ionized Heavy Ions," I. A. Sellin, C. R. Vane, K.-O. Groeneveld, R. Laubert, F. Chen, S. B. Elston, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Thoe, Z. Physik A 283, 329 (1977).

"The Violent Many-Electron Chemistry of Highly Charged Ions," I. A. Sellin, in Physics News - 1977, G. Present, ed. (American Institute of Physics, New York), p. 18 (1977).

"A Survey of Problems in Beam-Foil Spectroscopy of Iron and Copper of Energies from 16 to 110 MeV," S. Bashkin, J. Leavitt, D. J. Pisano, K. W. Jones, P. M. Griffin, D. J. Pegg, I. A. Sellin and T. H. Kruse, Nucl. Inst. and Meth. 154, 169 (1978).

"Many-Electron Transitions in Violent Encounters of Highly Ionized Ions with Atoms and Molecules," I. A. Sellin, J. R. Mowat, Comments on Atomic and Molecular Physics 8, Nos. 1-2, 21 (1978).

"Continuum Electron Capture Dependence on Projectile Z and Velocity," C. R. Vane, I. A. Sellin, M. Suter, G. Alton, S. B. Elston, P. M. Griffin, and R. S. Thoe, Z. Physik-Short Notes 286, 233 (1978).

"Failure of Single-Electron Descriptions of Molecular Orbital Collision Processes," S. B. Elston, IEEE Trans. Nuc. Sci. NS-26, 1037 (1978).

"Z, Velocity, and Charge Dependence of Zero-Degree Electron 'Cusps' from Charge Transfer to Continuum States of Bare and Highly Ionized Projectiles," C. R. Vane, I. A. Sellin, M. Suter, G. Alton, S. B. Elston, P. M. Griffin, and R. S. Thoe, Phys. Rev. Lett. 40, 1020 (1978).

"Observation of Oscillatory (Interference?) Structure in the Forward Peak from Fast-Projectile Electron Loss," M. Suter, C. R. Vane, I. A. Sellin, S. B. Elston, G. D. Alton, R. S. Thoe, and R. Laubert, Phys. Rev. Lett. 41, 399 (1978).

"Z, Velocity and Target Material Dependence of Convoy Electrons from Solids," R. Laubert, I. A. Sellin, C. R. Vane, M. Suter, S. B. Elston, G. D. Alton, and R. S. Thoe, Phys. Rev. Lett. 41, 712 (1978).

"Coherent Electron Density Distribution Oscillations in Electron Capture by Fast Protons in He," L. Liljeby, S. Mannervik, S. Hultberg, and I. A. Sellin, Z. Physik-Short Notes 258, 321 (1978).

"Electron 'Cusp' Spectroscopy of the Forward Peak in Continuum Electron Capture and Loss in Gases and Solids," I. A. Sellin, Journal de Physique Colloque, Supp. no. 2, 40, C1-225 (1979).

"Observation of Mixed Parity Electric Dipole Oscillations in Charge Transfer to the $n=2$ Hydrogen Levels by Fast Protons in Gases," I. A. Sellin, L. Liljeby, S. Mannervik, and S. Hultberg, Phys. Rev. Lett. 42, 570 (1979).

"Electron Capture Collisions at keV Energies of Boron and Other Multiply Charged Ions with Atoms and Molecules. I: Ar, H₂, and He," L. D. Gardner, J. E. Bayfield, P. M. Koch, I. A. Sellin, D. J. Pegg, R. S. Peterson, M. L. Mallory, and D. H. Crandall, Phys. Rev. A 20, 766 (1979).

"Delayed Coincidence Auger Electron Lifetime Measurements," S. Schumann, I. A. Sellin, R. Mann, H. J. Priskorn, D. Rosich, G. Szabo, and K.-O. Groeneveld, Journal de Physique Colloque, Supp. au no. 2, 40, C1-221 (1979).

"Orbital Angular Momentum State Coherence in Charge Transfer to the $n=2$ Hydrogen Levels by Fast Protons in Gases," L. Liljeby, S. Mannervik, S. Hultberg, and I. A. Sellin, Proceedings of the International Workshop on Coherence and Correlation in Atomic Collisions, Plenum Press, New York, 1979.

"Observation of Intense Low Energy Autoionization Lines in the Wings of the Forward Peak from Fast Ion-Atom Collisions," M. Suter, C. R. Vane, S. B. Elston, G. D. Alton, P. M. Griffin, R. S. Thoe, L. Williams, I. A. Sellin, and R. Laubert, Z. Phys. A 282, 433 (1979).

"Coincidence Observations of Strong Correlations Between Bound- and Continuum-State Electron Capture by Fast, Highly Ionized Ions in Gases," C. R. Vane, I. A. Sellin, S. B. Elston, M. Suter, R. S. Thoe, G. D. Alton, S. D. Berry, and A. Glass, Phys. Rev. Lett. 43, 1388 (1979).

"Continuum Electron Capture," S. B. Elston, in Physics News, 1979 (American Institute of Physics, New York, 1979), p. 25.

"Many-Electron Aspects of Molecular Promotion in Ion-Atom Collisions: Production of Core-Excited States of Li in Li-He Collisions," S. B. Elston, S. Schumann, and C. R. Vane, Phys. Rev. A 19, 962 (1979).

"Yield of Convoy Electrons from Solids," R. Laubert, I. A. Sellin, C. R. Vane, M. Suter, S. B. Elston, G. D. Alton, and R. S. Thoe, Nucl. Inst. and Meth. 170, 557 (1980).

"Electron-Capture Collisions at KeV Energies of Boron and Other Multiply Charged Ions with Atoms and Molecules. II. Atomic Hydrogen, L. D. Gardner, J. E. Bayfield, P. M. Koch, I. A. Sellin, D. J. Pegg, R. S. Peterson, and D. H. Crandall, Phys. Rev. A 21, 1397 (1980).

"Initial Tests of Possible Second Born-Induced Asymmetry in Forward Electron Ejection by Fast Bare Nuclei," M. Breinig, S. B. Elston, I. A. Sellin, L. Liljeby, R. S. Thoe, C. R. Vane, H. Gould, R. Marrus, and R. Laubert, Phys. Rev. Lett. 45, 1689 (1980).

"Coincidence Experiments Concerning Convoy Electron Production by 1 to 8.5 MeV/u Highly Ionized Ions Traversing Polycrystalline Solids and Axial Channels in Gold," S. B. Elston, I. A. Sellin, M. Breinig, S. Hultdt, L. Liljeby, R. S. Thoe, S. Datz, S. Overbury, and R. Laubert, Phys. Rev. Lett. 46, 321 (1981).

"Continuum Capture in the Three-Body Problem," I. A. Sellin, in Atomic Physics 7, ed. by D. Kleppner and F. Pipkin (Plenum Press, New York and London, 1981), p. 455.

"Multiple Ionization and Excitation Processes in Single Ion-Atom Collisions," S. B. Elston, Proceedings of the 1980 International Conference on the Physics of X-Ray Spectra and Inner-Shell Ionization Phenomena, D. Fabian, ed. (Plenum Press, New York and London, 1981), p. 127.

"Electron Capture and Loss to Continuum States in Gases and Solids," I. A. Sellin and R. Laubert, in Inelastic Particle-Surface Collisions, ed. by E. Tagliauer and W. Heiland (Springer-Verlag, Berlin, Heidelberg and New York, 1981), p. 120.

"Convoy Electrons from Solids in Coincidence with Emergent Projectile Charge State," R. Laubert, S. Hultdt, M. Breinig, L. Liljeby, S. Elston, R. S. Thoe and I. A. Sellin, J. Phys. B 14, 859 (1981).

"Velocity Dependence of the Widths of Electron Loss Cusps in the Range 7-12.5 au," M. Breinig, M. M. Schauer, I. A. Sellin, S. B. Elston, C. R. Vane, R. S. Thoe, and M. Suter, J. Phys. B 14, L291 (1981).

"Convoy Electron Production in Polycrystalline and Monocrystalline Targets," S. Huldt, IEEE Trans. Nucl. Sci. NS-28, 1139 (1981).

"Convoy Electron Production by 1 to 8.5 MeV/u Highly Ionized Ions Traversing Polycrystalline Solids and Axial Channels in Gold," I. A. Sellin, S. Huldt, S. B. Elston, M. Breinig, L. Liljeby, R. S. Thoe, S. Datz, S. Overbury, and R. Laubert, Proceedings of the Bat-Sheva Seminar on Molecular Ions, Molecular Structure and Interaction with Matter, Israeli Phys. Soc. 4, 201 (1981).

"Convoy Electron Production in Heavy Ion-Solid Collisions," I. A. Sellin, M. Breinig, W. Brandt, and R. Laubert, Nucl. Inst. and Meth. 194, 395 (1982).

"Electron Capture and Loss to Continuum," I. A. Sellin, in Physics of Electronic and Atomic Collisions, ed. by S. Datz (North-Holland Publishing Co., Amsterdam, 1982), p. 195.

"Fast Electrons, Slow Ions, and Super-Rydberg Cascades," I. A. Sellin, S. B. Elston, M. Breinig, and S. Huldt, Nucl. Inst. and Meth.

"Experiments Concerning Electron Capture and Loss to the Continuum and Convoy Electron Production by Highly Ionized Projectiles in the 0.7 to 8.5 MeV/u Range Traversing the Rare Gases, Polycrystalline Solids and Axial Channels in Gold," M. Breinig, S. B. Elston, S. Huldt, L. Liljeby, C. R. Vane, S. D. Berry, G. A. Glass, M. Schauer, I. A. Sellin, G. D. Alton, S. Datz, S. Overbury, R. Laubert, and M. Suter, Phys. Rev. A 25, 3015 (1982).

"Studies of Collision Interactions and Kinetic Energy Distributions of 10 eV Recoil Ions Inside Penning Traps," D. A. Church, R. Kenefick, W. S. Burns, I. A. Sellin, M. Breinig, S. B. Elston, S. Huldt, R. Holmes, J.-P. Rozet and S. Berry, to be published in the Proceedings of the Symposium on Production and Physics of Highly Charged Ions, Atomfysik Research Institute of Physics, Stockholm, Sweden, June 1982.

"Studies of Fast Beam Produced Recoil Ions in a Penning Trap," W. S. Burns, D. A. Church, R. A. Kenefick, S. B. Elston, R. Holmes, D. Taylor, J.-P. Rozet, S. Berry and I. A. Sellin, to be published in the Proceedings of the 7th Conference on the Application of Accelerators in Research and Industry, North Texas State University, Denton, Texas, November 1982.

"Comment on High Rydberg State Production in Convoy Electron Experiments," M. Breinig, S. B. Elston, S. D. Berry, G. A. Glass, I. A. Sellin, and C. R. Vane, to be published in Phys. Rev. Lett. (1982).

Abstracts and Contributed Papers

"Metastable States of Highly Excited Heavy Ions," with D. J. Pegg, P. M. Griffin, W. W. Smith, and B. Donnally, Presented at the Second International Conference on Atomic Physics, Boulder, Colorado, August, 1972.

"Electron Spectroscopy of Foil-Excited Chlorine Beams," with D. J. Pegg, P. M. Griffin, and W. W. Smith, presented at the Third International Conference on Beam-Foil Spectroscopy, Tucson, Arizona, October, 1972.

"Mean Life of the Metastable 2^3P_1 State of the Two-Electron Fluorine Ion," with J. R. Mowat, R. S. Peterson, D. J. Pegg, J. R. Macdonald, M. D. Brown, Bull. Am. Phys. Soc. 18, 610 (1973).

"Exponential Projectile Charge Dependence of Ar K and Ne K X-Ray Production by Fast, Highly Ionized Argon Beams in Thin Neon Targets," with J. R. Mowat, D. J. Pegg, R. S. Peterson, J. R. Macdonald and M. D. Brown, presented at the Eighth International Conference on the Physics of Electronics and Atomic Collisions, Belgrad, Yugoslavia, July, 1973.

"Electron Spectra from the Decay-in-Flight of Metastable Autoionizing States Associated with Highly Excited Heavy Ions," with D. J. Pegg, R. Peterson, and J. R. Mowat, Bull. Am. Phys. Soc. 18, 1527 (1973).

"Binding Energy and Lifetime of the $(1s2s2p)^4P^0_{5/2}$ State in Lithiumlike Sulfur," with H. Haselton, D. J. Pegg, P. M. Griffin, R. Laubert, J. R. Mowat, and R. Peterson, Bull. Am. Phys. Soc. 18, 1527 (1973).

"Projectile Structure Effects in Heavy-Ion-Induced K X-Rays: Target X-Rays," with J. R. Mowat, P. M. Griffin, D. J. Pegg, and R. S. Peterson, Bull. Am. Phys. Soc. 18, 1508 (1973).

"Projectile Structure Effects in Heavy-Ion-Induced K X-Rays: Projectile X-Rays," with J. R. Mowat, P. M. Griffin, D. J. Pegg, and R. S. Peterson, Bull. Am. Phys. Soc. 18, 1508 (1973).

"Effective Charge State of Heavy Ions Penetrating Solids Deduced from Comparing X-Ray Yields in Gases and Solids," with S. Datz, J. R. Mowat, B. Appleton, J. A. Biggerstaff, and C. D. Moak, Bull. Am. Phys. Soc. 18, 1508 (1973); presented at the Third International Conference on Atomic Collisions in Solids, Gatlinburg, Tennessee, September, 1973.

"Observation of Coherently Excited Dipole Charge Distribution Oscillations in Collision-Averaged Foil Excitation of the $n=2$ H Levels," with R. S. Peterson, J. R. Mowat, P. M. Griffin, H. Haselton, and R. Laubert, Bull. Am. Phys. Soc. 18, 1527 (1973).

"Observation of K X-Rays from Highly Ionized States of Neon Produced by 40 MeV Cl^{+7} , Cl^{+11} , and Cl^{+13} Beams," with M. D. Brown, J. R. MacDonald, P. Richard, and J. R. Mowat, Bull. Am. Phys. Soc. 19, 89 (1974).

"XUV Spectra of Highly Stripped Oxygen and Fluorine," with D. J. Pegg, P. M. Griffin, H. H. Haselton, R. Laubert, J. R. Mowat, R. S. Thoe, and R. S. Peterson, Bull. Am. Phys. Soc. 19, 469 (1974).

"Improvements in the Use of Grazing Incidence Spectrometers to Study Spectra of Low Intensity, Highly Stripped Ion Beams," with P. M. Griffin, R. S. Thoe, H. H. Haselton, R. Laubert, R. S. Peterson, J. R. Mowat, and D. J. Pegg, Bull. Am. Phys. Soc. 19, 469 (1974).

"Ne and Ar K X-Ray Satellite Production," with J. R. Mowat, R. Laubert, M. D. Brown, R. L. Kauffman, J. R. MacDonald, and P. Richard, Bull. Am. Phys. Soc. 19, 570 (1974).

"K X-ray Yields from Single Collisions of ~ 100 MeV Cl Ions with Si," with S. J. Czuchlewski, M. D. Brown, J. R. MacDonald, L. M. Winters, R. Laubert, and J. R. Mowat, Bull. Am. Phys. Soc. 19, 590 (1974).

" $n=2$ Finestructure Decays in He-like F," with J. R. Mowat, P. M. Griffin, R. S. Peterson, H. H. Haselton, R. Laubert, D. J. Pegg, and R. S. Thoe, Bull. Am. Phys. Soc. 19, 468 (1974).

"Charge State Dependent Energy Shifts of K X-ray Accompanying Nearly Symmetric Collisions of 3 MeV/amu S and Cl Ions," with R. Laubert, J. R. Mowat, M. D. Brown, S. Czuchlewski, J. R. MacDonald, and L. Winter, Bull. Am. Phys. Soc. 19, 590 (1974).

"X-Ray Cross Sections in Symmetric Ion-Atom Collisions," with J. R. Mowat, R. Laubert, H. Haselton, and R. S. Peterson, Bull. Am. Phys. Soc. 19, 570 (1974).

"Observations of Non-Characteristic Combined Atom K-Shell X-Ray Band in Al-Al Collisions," with R. Laubert, H. Haselton, J. R. Mowat, and R. S. Peterson, Bull. Am. Phys. Soc. 19, 590 (1974).

"Autoionization Lifetimes of the Metastable $(1s2s2p)^4P_{5/2}$ State in the Lithium-like Ions Al^{10+} , Si^{11+} , and S^{13+} ," with H. H. Haselton, R. S. Thoe, P. M. Griffin, J. R. Mowat, D. J. Pegg, and R. Peterson, presented at the Fourth International Conference on Atomic Physics, Heidelberg, West Germany, July, 1974.

"Lifetimes and Binding Energies of the Metastable Autoionizing $(1s2s2p)^4P_{5/2}$ State in Al^{10+} and Si^{11+} ," with R. S. Thoe, H. H. Haselton, P. M. Griffin, J. R. Mowat, R. S. Peterson, and D. J. Pegg, Bull. Am. Phys. Soc. 19, 1176 (1974).

"Characterization of Charge States of Energetic Ions in Solids from Associated K X-Ray Production," with S. Datz, B. R. Appleton, J. R. Mowat, R. Laubert, R. S. Peterson, and R. S. Thoe, Bull. Am. Phys. Soc. 19, 1184 (1974).

"Electron Spectroscopy of Autoionizing States in LiI and NaI," with D. J. Pegg, H. H. Haselton, M. D. Brown, R. S. Thoe, P. M. Griffin, and W. W. Smith, Bull. Am. Phys. Soc. 19, 1184 (1974).

"Energy Dependence of the Directional Anisotropy Exhibited by Quasimolecular K X-Radiation," with R. S. Thoe, M. D. Brown, J. P. Forester, P. M. Griffin, D. J. Pegg, and R. S. Peterson, Bull. Am. Phys. Soc. 20, 75 (1975).

"Charge State Dependence of X-Ray Production of Collisions of Ni (~ 1 MeV/amu) with SiH_4 ," with S. Datz, M. D. Brown, P. M. Griffin, R. S. Peterson, and R. S. Thoe, Bull. Am. Phys. Soc. 20, 639 (1975).

"Electron Spectra from the Autoionizing Decay of Collisionally Excited Mg^+ and K^+ Beams," with D. J. Pegg, H. H. Haselton, M. D. Brown, R. S. Thoe, and P. M. Griffin, Bull. Am. Phys. Soc. 20, 674 (1975).

"Non-Characteristic Spectra from Symmetric and Asymmetric Collision Systems," with R. S. Thoe, D. J. Pegg, J. P. Forester, K.-H. Liao, R. S. Peterson, and P. M. Griffin, *Bull. Am. Phys. Soc.* 20, 675 (1975).

"Electron Spectra from Autoionizing States of Highly Stripped Oxygen and Fluorine," with R. S. Peterson, J. P. Forester, P. M. Griffin, H. H. Haselton, K.-H. Liao, J. R. Mowat, D. J. Pegg, and R. S. Thoe, *Bull. Am. Phys. Soc.* 20, 679 (1975).

"Autoionizing States in Lithiumlike Si and Sodiumlike Cl," with J. P. Forester, P. M. Griffin, H. H. Haselton, K.-H. Liao, J. R. Mowat, D. J. Pegg, R. S. Peterson, and R. S. Thoe, *Bull. Am. Phys. Soc.* 20, 679 (1975).

"Beam-Foil Spectra of Iron, Copper, and Silicon, with S. Bashkin, J. A. Leavitt, K. W. Jones, D. Pisano, T. Kruse, P. Griffin, and D. Pegg, *Bull. Am. Phys. Soc.* 20, 1452 (1975).

"Comparison of Production of Non-Characteristic X-Ray Radiation in Solid (Al) and Gaseous (SiH₄) Targets," with R. Peterson, R. Laubert, R. S. Thoe, H. Hayden, S. Elston, J. Forester, K.-H. Liao, P. M. Griffin, and D. J. Pegg, *Bull. Am. Phys. Soc.* 20, 1450 (1975).

"Characteristic K X-Ray Production from High Energy Al-Al Collisions," with R. S. Thoe, J. P. Forester, R. S. Peterson, D. J. Pegg, P. M. Griffin, and K.-H. Liao, *Bull. Am. Phys. Soc.* 21, 640 (1976).

"Beam-foil Radiative Lifetime Measurements in SiIX-SiXII," with D. J. Pisano and K. W. Jones of Brookhaven National Lab, P. M. Griffin and D. J. Pegg of O.R.N.L., T. Kruse of Rutgers, and S. Bashkin of the University of Arizona, *Bull. Am. Phys. Soc.* 21, 689 (1976).

"Lifetimes and Spectra of Highly Ionized Sulfur," with S. B. Elston, D. J. Pegg, P. M. Griffin, J. P. Forester, H. C. Hayden, R. S. Peterson, and R. S. Thoe, *Bull. Am. Phys. Soc.* 21, 626 (1976).

"Radiative Electron Capture Cross Sections for High Energy Al-Al and Al-C Collisions," with R. S. Thoe, J. P. Forester, D. J. Pegg, R. S. Peterson and K.-H. Liao, *Bull. Am. Phys. Soc.* 21, 650 (1976).

"Single and Double Electron Transfer in B^{q+} (q = 2,3,4) Collisions with He, Ar, and H₂," with J. E. Bayfield, P. M. Koch, L. D. Gardner, D. J. Pegg, R. S. Peterson, D. H. Crandall, and M. L. Mallory, *Bull. Am. Phys. Soc.* 21, 549 (1976).

"An Experimental Survey of Electron Transfer in keV Collisions of Multiply Charged Ions with Atomic Hydrogen," with J. E. Bayfield, P. M. Koch, L. D. Gardner, D. J. Pegg, R. S. Peterson, and D. H. Crandall, presented at the Fifth International Conference on Atomic Physics, Berkeley, Calif., July, 1976.

"Lifetimes and Transition Rates for Allowed 'In-Shell' Transitions in Highly Stripped Sulfur," with D. J. Pegg, S. B. Elston, J. P. Forester, P. M. Griffin, H. C. Hayden, R. S. Peterson, and R. S. Thoe, presented at the Fifth International Conference on Atomic Physics, Berkeley, Calif., July, 1976.

"Radiative Lifetimes and Oscillator Strength for the $n=2$ States of Be-like Sulfur," with J. P. Forester, D. J. Pegg, S. B. Elston, P. M. Griffin, K.-O. Groeneveld, R. S. Peterson, R. S. Thoe, and C. R. Vane, *Bull Am. Phys. Soc.* 21, 1253 (1976).

"A Beam-Foil Study of the $2s^2S-2p^2P^0$ Doublet in Li-like Sulfur," with C. R. Vane, D. J. Pegg, S. B. Elston, J. P. Forester, P. M. Griffin, K.-O. Groeneveld, R. S. Peterson, and R. S. Thoe, *Bull Am. Phys. Soc.* 21, 1252 (1977).

"Mass Dependence of Ne K X-Ray Yields from Ne^+-Ne Collisions at keV Energies," with R. S. Peterson, S. B. Elston, R. Laubert, F. K. Chen, and C. A. Peterson, *Bull. Am. Phys. Soc.* 21, 1248 (1977).

"Measurement of the H^++H Charge Exchange Cross Section, 0.8-2.5 MeV," with L. D. Gardner, P. M. Koch, J. E. Bayfield, H. Hayden, R. Thoe, J. Forester, and D. J. Pegg, in *Bull. Am. Phys. Soc.* 21, 1265 (1977).

"Der $2s^2S-2p^2P^0$ Doublettübergang in Li-ähnlichem Schwefel," with C. R. Vane, D. J. Pegg, S. B. Elston, J. P. Forester, P. M. Griffin, K.-O. Groeneveld, and R. S. Thoe, *Verhandl., Deutsche Physikalische Gesellschaft* 2/1977, 500 (1977).

"Lebensdauern und Oszillatorenstärken von $n=2$ Zuständen in Be-ähnlichem S," with J. P. Forester, D. J. Pegg, S. B. Elston, P. M. Griffin, K.-O. Groeneveld, R. S. Peterson, R. S. Thoe, and C. R. Vane, *Verhandl., Deutsche Physikalische Gesellschaft* 2/1977, 500 (1977).

"An Application of the Beam Foil Method to Transitions of Astrophysical Interest," with D. J. Pegg, J. P. Forester, P. M. Griffin, C. R. Vane, S. B. Elston, R. S. Thoe, H. C. Hayden, K. O. Groeneveld, and R. S. Peterson, presented at the American Physical Society Topical Conference on Atomic Processes in High Temperature Plasmas, Knoxville, February, 1977.

" $An=0$ Transitions in Highly Ionized Ions," with D. J. Pegg, P. M. Griffin, S. B. Elston, J. P. Forester, K. O. Groeneveld, H. C. Hayden, R. S. Peterson, R. S. Thoe, and C. R. Vane, in *Proceedings, Nordic Symposium on Atomic and Molecular Transition Probabilities*, I. Martinson, ed. (Lunds Univeristet, Lund), p. 8 (1977).

"Production of Core-Excited States of Li and Li^+ in Collisions with Gas Targets, with S. B. Elston, C. R. Vane, J. P. Forester, D. J. Pegg, and S. R. Schumann, *Bull. Am. Phys. Soc.* 22, 655 (1977).

"Projectile Charge-State Dependence in K-Shell Ionization of Neon, Silicon, and Argon Cases by Lithium Projectiles, with F. K. Chen, G. Lapicki, R. Laubert, S. B. Elston, and R. S. Peterson, *Bull. Am. Phys. Soc.* 22, 655 (1977).

"Lower Limits on Resolved Neon L-shell Excitation Cross-sections by Impact of 1.5 MeV/A $\sim Si^{12+}$, Cl^{12+} Ions," with C. R. Vane, S. B. Elston, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Peterson, R. S. Thoe, J. Wright, K. O. Groeneveld, R. Laubert, and F. Chen, *Bull Am. Phys. Soc.* 22, 609 (1977).

"Recoil Ion Spectroscopy: Reduction of Doppler Shifts and Spreads in Fast Beam Experiments, with C. R. Vane, S. B. Elston, J. P. Forester, P. M. Griffin, D. J. Pegg, R. S. Peterson, R. S. Thoe, and K. -O. Groeneveld, *Bull. Am. Phys. Soc.* 22, 610 (1977).

"Measurement of Alignments in Single Ion-Atom Collisions by a Quantum Beat Method", with J. Bromander, L. Liljeby, and L. Lundin, presented at the Fourth International Seminar on Ion-Atom Collisions, Darmstadt, Germany, July, 1977.

"Target Specificity Effects on the Production of Core-Excited States of Li and Li^+ for 10 to 50 keV Collisions of Li^+ with Gas Targets", with S. B. Elston, C. R. Vane, J. P. Forester, P. M. Griffin, D. J. Pegg, S. Schumann, M. Suter and R. S. Thoe to be published in Bull. Am. Phys. Soc., November, 1977.

"Stark Shifts and Broadening of Auger Lines of Highly Ionized Atoms in Molecules After Heavy Ion Impact", with R. Mann, F. Folkmann, H. J. Frischkorn, K. O. Groeneveld, D. Rosich, S. Schumann, and Gy. Szabo, Bull. Am. Phys. Soc. 22, 1320 (1977).

"Quantum Beat Method of Measuring Alignments in Single Ion-Atom Collisions," with J. B. Bromander, L. Liljeby, and L. Lundin, Bull. Am. Phys. Soc. 22, 1320, (1977).

"Metastable Auger Emitter Lifetimes by a Delayed Coincidence Technique," with R. Mann, H. J. Frischkorn, D. Rosich, S. Schumann, and Gy. Szabo, Bull. Am. Phys. Soc. 22, 1320 (1977).

"Lebensdauern metastabiler Dreielektronen - Zustände mit einer Koinzidenz Technik", with H. J. Frischkorn, D. Rosich, S. Schumann, Gy. Szabo, and K. O. Groeneveld, Verhandl., Deutsche Physikalische Gesellschaft, 2/1978, 424 (1978).

"Lebensdauerermessung von Metastabilen Zuständen mit verzögerter Koinzidenz nach Anregung mit gepulstem UNILAC - Strahl, with R. Mann, H. J. Frischkorn, D. Rosich, S. Schumann, G. Szabo, and K. O. Groeneveld, in Beitrag für GSI - Nachrichten 2-78, (1978).

"Projectile Velocity Dependence in Li Core Excitation in Single Collisions with He Targets," with S. B. Elston, C. R. Vane, J. P. Forester, P. M. Griffin, D. J. Pegg, S. Schumann, M. Suter and R. S. Thoe, Bull. Am. Phys. Soc. 23, 513 (1978).

"Projectile Charge State Dependence of Zero Degree Electron "Cusps" from C^{q+} ($q = 4-6$) and O^{q+} ($q = 4-8$) Traversing Ar at 1.6 MeV/A to 2.8 MeV/A", with M. Suter, R. S. Thoe, G. D. Alton, S. B. Elston, P. M. Griffin, and C. R. Vane, Bull. Am. Phys. Soc. 23, 513 (1978).

"Charge Transfer to Continuum States of Bare and Highly Ionized Projectiles", with C. R. Vane, M. Suter, G. D. Alton, S. B. Elston, P. M. Griffin, and R. S. Thoe, Bull. Am. Phys. Soc. 23, 512 (1978).

"Z Dependence and Velocity Dependence of Zero Degree Electron "Cusps" from C^{6+} and O^{8+} Traversing Ar at 1.6 MeV/A to 2.8 MeV/A," with C. R. Vane, M. Suter, G. D. Alton, S. B. Elston, P. M. Griffin, and R. S. Thoe, Bull. Am. Phys. Soc. 23, 512 (1978).

"Search for Correlation Effects Between Multiple Electron Loss to Continuum Events in High Energy O^{+4} -Ar Collisions," R. S. Thoe, C. R. Vane, S. B. Elston, P. M. Griffin, G. D. Alton, G. Glass, L. E. Williams, and M. Suter, Bull. Am. Phys. Soc. 23, 1086 (1978).

"Creation of Mixed-Parity Excited States in $H(n=2)$ Following Single, Charge Transfer Collisions of Fast H^+ in Gases," with L. Liljeby, S. Mannervik, and S. Hultberg, presented at the International Conference on Fast Ion Spectroscopy, Université de Lyon, September, 1978.

"Electron Capture to Continuum States by Bare Projectile Ions," C. R. Vane, M. Suter, I. A. Sellin, G. D. Alton, S. B. Elston, P. M. Griffin, and R. S. Thoe, Bull. Am. Phys. Soc. 23, 1086 (1978).

"Systematics of Continuum Capture and Loss by Bare and Highly Ionized H, C, O, and Si Projectil~~e~~ Ions Traversing He, Ne, and Ar Targets," S. B. Elston, I. A. Sellin, M. Suter, C. R. Vane, G. D. Alton, P. M. Griffin and R. S. Thoe, Bull. Am. Phys. Soc. 23, 1086 (1978).

"Observation of Strong Structure in the Forward Peak from Fast-Projectile Electron Loss," M. Suter, C. R. Vane, I. A. Sellin, S. B. Elston, G. D. Alton, R. S. Thoe and R. Laubert, Bull. Am. Phys. Soc. 23, 1086 (1978).

"Search for Correlation Effects Between Multiple Electron Loss to Continuum Events in High Energy O^{+4} - Ar Collisions," R. S. Thoe, C. R. Vane, S. B. Elston, P. M. Griffin, G. D. Alton, G. Glass, L. E. Williams, and M. Suter, Bull. Am. Phys. Soc. 25, 1086 (1978).

"Molecular Modulation of $H(n=4)$ Quantum Beats Following Single Foil Excitation of H^+ , H_2 and H_3 Beams," L. Liljeby, B. Jelenkovic, S. Mannervik, S. Hultberg and I. A. Sellin, Bull. Am. Phys. Soc. 23, 1099 (1978).

"Consequences for Parity Violation Experiments of Creation of Mixed Parity Excited States in $H(n=2)$ Following Single Collisions of Fast H^+ in Gases," I. A. Sellin, L. Liljeby, S. Mannervik and S. Hultberg, Bull. Am. Phys. Soc. 23, 1095 (1978).

"Coincidence Experiments on Electron Loss to Low Lying Projectile-Centered Continuum States of One, Two, and Three Electron Loss Events in High Velocity C+Ar Collisions," R. S. Thoe, C. R. Vane, S. B. Elston, I. A. Sellin, M. Suter, L. Williams, G. D. Alton, P. M. Griffin, and R. Laubert, Bull. Am. Phys. Soc. 24, 581 (1979).

"K-Aug~~e~~r Electrons Observed in Coincidence with Final Projectile Charge State in ~ 1.5 MeV/A Ion-Atom Collisions," M. Suter, C. R. Vane, S. B. Elston, G. D. Alton, P. M. Griffin, R. S. Thoe, L. Williams, I. A. Sellin, and R. Laubert, Bull. Am. Phys. Soc. 24, 582 (1979).

"Yield of Convoy Electrons from Solids," I. A. Sellin, R. Laubert, C. R. Vane, M. Suter, S. B. Elston, G. D. Alton, and R. S. Thoe, presented at the Eighth International Conference on Atomic Collisions in Solids, Hamilton, Canada, August 1979.

"Target Dependences for Continuum Capture Processes in Ion-Atom Collisions," C. R. Vane, I. A. Sellin, M. Suter, S. B. Elston, G. D. Alton, and R. S. Thoe, Abstracts of Contributed Papers, Eleventh International Conference on the Physics of Electronic and Atomic Collisions, Kyoto, Japan, September 1979, p. 752.

"Coincidence Experiments Concerning Forward Electron Ejection," I. A. Sellin, M. Suter, C. R. Vane, S. B. Elston, R. S. Thoe, and G. D. Alton, Abstracts of Contributed Papers, Eleventh International Conference on the Physics of Electronic and Atomic Collisions, Kyoto, Japan, September 1979, p. 754.

"K-Auger Electrons Observed in Coincidence with Final Projectile Charge State in Ion-Atom Collisions," M. Suter, C. R. Vane, S. B. Elston, I. A. Sellin, R. S. Thoe, and G. D. Alton, Abstracts of Contributed Papers, Eleventh International Conference on the Physics of Electronic and Atomic Collisions, Kyoto, Japan, September 1979, p. 762.

"Coincidence Spectroscopy of Continuum Electron Transfer in Heavy Ion Collisions," I. A. Sellin, in Abstracts of the Sixth International Seminar on Ion-Atom Collisions, H. Tawara, K. Ozawa, and Y. Nakai, eds. (Japan Atomic Energy Research Institute, Tokai-mura, 1979), p. 2.

"Coincident Capture of Bound and Continuum Electrons by Fully Stripped C and O Projectiles in ~ 1 MeV/A Single Collisions with Ar Targets," C. R. Vane, I. A. Sellin, S. B. Elston, M. Suter, R. S. Thoe, G. D. Alton, S. D. Berry, and G. A. Glass, Bull. Am. Phys. Soc. 24, 1179 (1979).

"Electron-Ion Coincidence Spectroscopy of Multi-electron K-ionizing Processes in Single Collisions of ~ 1 MeV/A C^{q+} and O^{q+} Projectiles with Ar Targets," M. Suter, C. R. Vane, I. A. Sellin, R. S. Thoe, S. B. Elston, G. D. Alton, S. D. Berry, G. A. Glass, Bull. Am. Phys. Soc. 24, 1179 (1979).

"Velocity and Target Dependences for Charge Capture to Continuum in High Velocity Ar^{18+} + Gas Target Collisions," S. Elston, I. Sellin, M. Breinig, L. Liljeby, R. Thoe, R. Marrus, H. Gould, C. R. Vane, and R. Laubert, Bull. Am. Phys. Soc. 25, 511 (1980).

"Shape of Electron Capture to Continuum Peaks for High Velocity Ar^{18+} Gas Target Collisions," C. R. Vane, R. Marrus, H. Gould, I. A. Sellin, M. Breinig, S. B. Elston, L. Liljeby, and R. S. Thoe, Bull. Am. Phys. Soc. 25, 512 (1980).

"Convoy Electrons from Solid Targets for 234 and 340 MeV Argon Projectiles," R. Laubert, H. Gould, R. Marrus, C. R. Vane, I. A. Sellin, S. B. Elston, M. Breinig, L. Liljeby, S. Berry, and R. S. Thoe, Bull. Am. Phys. Soc. 25, 512 (1980).

"Production of Convoy Electrons by Highly Ionized Atoms Traversing Solids," S. B. Elston, I. A. Sellin, M. Breinig, S. Hultdt, L. Liljeby, and R. S. Thoe, Bull. Am. Phys. Soc. 25, 1126 (1980).

"Electron Capture to Continuum States by High-Velocity Ar^{18+} Ions Traversing He," M. Breinig, S. B. Elston, I. A. Sellin, L. Liljeby, R. S. Thoe, Bull. Am. Phys. Soc. 25, 1136 (1980).

"Systematic Study of Electron Loss Cusps in the Velocity Range 7-12 A.U.," M. M. Schauer, M. Breinig, I. A. Sellin, S. B. Elston, C. R. Vane, R. S. Thoe, M. Suter, and R. Laubert, Bull. Am. Phys. Soc. 26, 602 (1981).

"Width and Yields of Electron Loss Cusps in the Velocity Range 7-12.5 au," M. M. Schauer, S. B. Elston, C. R. Vane, I. A. Sellin, M. Breinig, R. S. Thoe, S. D. Berry, G. A. Glass, and M. Suter, Abstracts of Contributed Papers, XII International Conference on the Physics of Electronic and Atomic Collisions, Vol. 2, p. 802 (1981).

"Proton Loss to Projectile-Centered Continuum States for 7-57 keV Ar^{18+} Projectiles Traversing He, Ne, and Kr Targets," S. D. Berry, M. Breinig, I. A. Sellin, Abstracts of Contributed Papers, XII International Conference on the Physics of Electronic and Atomic Collisions, Vol. 2, p. 996 (1981).

"Storage of Heavy-Ion-Generated Recoil Ions in a Penning Trap," S. Hultdt, R. Holmes, S. Elston, S. Berry, M. Breinig, I. Sellin, W. Burns, R. Kenefick, and D. Church, Bull. Am. Phys. Soc. 26, 1304 (1981).

"Penning Trap Technique for Slow Recoil Ion Storage," W. Burns, D. Church, R. Kenefick, S. Berry, M. Breinig, S. Elston, R. Holmes, S. Hultdt, and I. Sellin, Bull. Am. Phys. Soc. 26, 1309 (1981).

"Charge Transfer and Energy Distribution Measurements on Stored, Highly Charged Ions," R. Holmes, M. Breinig, S. Elston, S. Hultdt, J. Rozet, I. Sellin, W. S. Burns, D. Church, and R. Kenefick, Bull. Am. Phys. Soc. 27, 513 (1982).

"Shape of the Electron Capture to the Continuum (ECC) Spectra for 17.6 au Ne^{10+} on He," S. Berry, I. A. Sellin, S. B. Elston, M. Breinig, N. Stolterfoht, H. Schmidt-Bücking, G. Nolte, and G. Schiwietz, Bull. Am. Phys. Soc. 27, 514 (1982).

"Isotope Effect in Electron Yield from Light and Clustered Projectile Ion Impact on Carbon," R. Latz, J. Schader, H. J. Frischkorn, P. Koschar, M. Burkhard, I. A. Sellin, and K.-O. Groeneveld, Abstracts of the Eighth International Conference on Atomic Physics, Göteborg, Sweden, August 1982, p. B 62.

"Shape and Yield of Electron Capture to the Continuum (ECC) Spectra for 15.4 au and 16.6 au Bare Oxygen Nuclei Traversing Helium Gas," S. D. Berry, I. A. Sellin, L. H. Andersen, M. Breinig, S. B. Elston, K.-O. Groeneveld and D. Hofmann, Abstracts of the Eighth International Conference on Atomic Physics, Göteborg, Sweden, August 1982, p. B 51.

"Shape of the Electron Capture to the Continuum (ECC) Spectra for 17.6 au Ne^{10+} on He," S. D. Berry, I. A. Sellin, S. B. Elston, M. Breinig, N. Stolterfoht, H. Schmidt-Bücking, G. Nolte and G. Schiwietz, Abstracts of the International Conference on X-Ray and Atomic Inner-Shell Physics, Eugene, Oregon, August 1982.